

ART. III.—THE LESIONS IN PARALYSIS AGITANS.

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IN 1871, at a meeting of the Wiener Gesellschaft der Aerzte, Professor Meynert delivered an address (Beitrage z. differential diagnose d. paralytischen Irr-sinnes, *Wien Medizin. Presse*, 1871, p. 645), in which he indicated the direction in which to seek for the pathological changes necessary to explain the interesting and characteristic group of symptoms, known as paralysis agitans. In this address Meynert records a case of dementia paralytica, in which paralysis agitans was present as a complication. He, with his usual readiness to apply his anatomical discoveries to the elucidation of the changes occurring in the brain necessary to produce a given combination of symptoms, diagnosed a lesion in the ganglia necessary for the production of voluntary movements, *i. e.*, the corpus lenticularis and corpus striatum.

At the autopsy this beautiful diagnosis was confirmed. The convolutions of both frontal lobes were equally atrophied. On the left side the "Stammlappen" (the Stamm of the Germans includes all portions of the brain with the exception of the hemispheres and cerebellum,) weighed but 38 grammes, while on the right it weighed 44 grammes; the decrease on the left side was solely due to atrophy of the nucleus lenticularis and corpus striatum.

Since this case, Meynert has had a second patient at his clinic, who presented similar symptoms, in whom the same diagnosis was made, and who at the autopsy presented similar changes. At the present time there is another patient in his wards who, besides the symptoms of dementia, also presents those of paralysis agitans,—commencing with tremor involving the face as well as the extremities, and which tremors cease when the patient is at rest. The patient is paretic and also presents the curious tendency to go forward—likewise backwards

should his coat-tail be pulled—when once started. In this case he has again made the diagnosis of a lesion in the corpus striatum.

The views of Meynert, that paralysis agitans is due to an irritative condition from hyperæmia in the gray substance of the anterior cerebral ganglia, producing interference, by compression, with the conduction of the impulses of the will, were confirmed by Nothnagel's experiments on the nucleus caudatus of animals (*Virchow's Archiv.* Bd. 57, p. 209). The investigation produced the symptoms of paralysis agitans by injected very small quantities only sufficient to irritate, of chromic acid into the nucleus caudatus.

It is, however, by no means absolutely necessary that the anterior cerebral ganglia should be the seat of the lesion, for other prosectors have found no lesions in other portions of the brain, these ganglia being apparently unaffected; and still others have found no lesions whatsoever; in regard to the latter I can only express the opinion that the changes were so minute as to be overlooked.

Before giving the lesions found by others in paralysis agitans, it will, perhaps, not be out of place to give a short resume of Meynert's "Projectionssystem," in so far as it relates to the conduction of impulses proceeding from the will—his so-called "Willensbahn." He divides the fibres of the "Willensbahn" into three links, or orders: the first link consists of the fibres passing from the peripheral grey matter of the anterior lobe of the hemispheres, to the nucleus lenticularis and corpus striatum. The second link of his "Projectionssystem" consists of the fibres of the pedunculus, of the pyramidal fibres and their continuation in the spinal cord down to the origin of the motor nerves, which latter constitutes the third link. All the pedunculus fibres do not continue their downward course with the pyramidal fibres, but at the pons some of them branch off into the cerebellum.

There have been, relatively, a large number of cases in which no lesion whatsoever was found after death, but certainly no one at the present time will venture to doubt there having been some lesion present which was overlooked; had the "Willensbahn" been carefully examined, I have no doubt

that in most of the cases it would have been found abnormal, it taking but a very slight lesion—a permanent change in its blood supply will probably suffice—to produce the symptoms of paralysis agitans. In the cases in which lesions were found it will be seen that they were found almost exclusively in the “Willensbahn,” or in addition, in organs which under no condition have anything to do with the symptoms of paralysis agitans, *e. g.*, the optic thalamus, lesions of which, as has been shown by Nothnagel (*loc. cit.*), produce none of these symptoms.

In a case recorded by Stoffela, (*Oppolzer's Klinik*) atrophy of the convolutions of the frontal and parietal tubes was found, which, if nothing else had been found, would have been sufficient to explain the symptoms, as has been very recently shown by Goltz (*Ueber d. Verrichtungen d. Grosshirns, Pflueger's Archiv.* 1876, Bd. 16, Hft. 1, p. 28), who observed in almost every case in which he removed portions of one hemisphere, in dogs, the animals made movements in a circle, the movements being directed towards the injured side; later the same animals showed the forward propulsion beautifully: paresis, of course, also occurred. Besides the atrophy in Oppolzer's case, there was found induration of the pons and medulla oblongata, and a small cyst in the thalamus.

Ordenstein (*Sur la paralysie agitante et la sclerose en plaques. Thèse de Paris*, 1867) found softening of both pedunculi cerebri and some loss of substance in the pons.

Meschede (*Virchow's Arch.* 50, Hft. 11,) found sclerotic spots in the corpus striatum and thalamus.

Parkinson (*Essay on Shaking Palsy*, 1817), the first describer of the disease, found in his case induration of the pons and medulla oblongata.

The lesions found by Joffroy (*Société de Biologie*, 1871,) were rightfully considered by himself to be the ordinary lesions of senile degeneration occurring in old people.

Finding the number of carefully reported cases of paralysis agitans too few on which to base an opinion, I next paid my attention to the lesions found in multiple cerebro-spinal sclerosis, in which disease paralysis agitans occurs as a symptom.

Schuele (*Deutsch. Arch.*, Bd. VII, p. 259, and Bd. VIII, p.

223,) found atrophy of, and hydrocephalus externum over, the convolutions of the anterior lobe of the brain; sclerosis extending from the motor ganglia to the cerebellum, involving both pedunculi cerebri. Sclerotic patches were also found in the reflex tract, which readily explain the gradual loss of reflex irritability in this case.

In a second case, Schuele found atrophy of the right frontal convolutions, the nucleus lenticularis reduced to less than half its usual size; the pedunculi cerebri, their pyramidal fibres, and the cerebellum were also involved.

Leo (*Deutsch. Arch.* Bd. IV, p. 157,) found on the right side, just beneath the nucleus lenticularis, five gaping arteries; in addition both pedunculi cerebri were sclerotic, the right markedly so.

In Leube's (*Deutsch. Arch.*, VIII, p. 1,) first case, there was atrophy of the frontal convolutions, hyperæmia of the right corpus striatum,—both it and its fellow on the left side had undergone grey degeneration in the periphery,—and sclerosis in the pons. In a second case he found grey degeneration of both corpora striata and of the pons.

Buchwald (*Deutsch. Arch.*, Bd. X, p. 478,) found the frontal portions of the hemispheres, and the corpora striata and nucleus lenticularis, involved.

Otto (*Deutsch. Arch.*, Bd. X, p. 531,) found atrophy of the frontal and parietal convolutions and lesions in the pons.

.Baerwinkel (*Deutsch. Arch.*, 1809, p. 590,) found grey degeneration in the corpora striata, in the pedunculi cerebri and in the pons.

In Jolly's case (*Arch. f. Psychiatrie u. Nervenkrankheiten*, Bd. III, p. 711,) there was atrophy, softening in the left corpus striatum, sclerosis of the pedunculi cerebri and pons. Jolly also reports a case of uncomplicated paralysis agitans, in which he found atrophy of the convolutions.

Moxon (*Lancet*, Feb. 15, 1873, p. 236,) found atrophy and grey degeneration of the corpora striata and thalami optici.

Having given the various autopsies, in every one of which the "Willensbahn" was to a greater or less extent involved, it now remains for me to explain the symptoms which they produced, on anatomical and physiological grounds.

The original impulse necessary to cause the movement of a set of muscles, originates in the peripheral grey matter of the hemispheres, and proceeds through the motor ganglia, the pedunculi cerebri, and then through the pyramidal fibres to the motor tract of the cord, from whence it proceeds along the necessary nerves to the muscles intended to be moved. This has been proved by the experiments of Longet, Magendie, Schiff, Goltz, and numerous other experimenters, who found that when the grey matter of the hemispheres is removed all voluntary movements cease.

The continuation of these movements devolves on the spinal cord, as has been shown by Goltz (*Beiträge zur Lehre v. d. Functionen d. Nervencentren d. Frosches*, p. 76,) and other experimenters.

The regulation or co-ordination of these movements depends not on the cerebellum, as has hitherto been supposed, but on the peripheral grey matter of the hemispheres, as is proved by the recent experiments of Goltz, (*Pflueger's Arch.*, Hft. 1, 1876,) who found that the animals from whom a portion of the hemispheres had been removed, were no longer able to co-ordinate their movements; and he having previously shown that the continuation of a series of movements depends on the cerebellum, I cannot do otherwise than consider the peripheral grey matter, and not it, the means by which the continued movements are regulated. For if the cerebellum co-ordinated the continuous movements, these movements would remain unaffected if all portions of the brain above the cerebellum were destroyed, which is contrary to the fact.

That the co-ordinating impulse passes along the fibres of the "Willensbahn," which leave the pedunculus cerebri at the pons to enter the cerebellum, has been found by the experiments of Longet, Magendie, Schiff, and others. Schiff, (*Physiologie*, Bd. 1, p. 343,) in making these sections of animals, found that the forward propulsion of the animal commenced in some instances, when the lobes of the hemispheres alone had been removed, and continued until he reached the pons (probably at the point where the pedunculus fibres pass into the cerebellum), where it ceased.

The objection may be urged against these statements, that

the forward propulsion and the propulsion in a circle, are not evidences of a want of co-ordination; to which I must reply that on the contrary they are characteristic evidences of this want, as otherwise the animal (or patient) would not be found to execute the movements against his will. These views are confirmed by the occurrence of other inco-ordinated movements in the animals operated upon.

Having seen that, physiologically, the symptoms so characteristic of paralysis agitans may be produced by irritation and section of any portion of the "Willensbahn" down to the cerebellum; and, having also seen that, pathologically, the prominent lesions of this disease, whether it occurs uncomplicated or as a symptom, are found in this tract, I think I am justified in arriving at the following conclusion: The symptoms of paralysis agitans are due to an irritation of the regulating or co-ordinating fibres in the voluntary motor tract of the brain, which fibres pass from the peripheral grey matter of the cerebrum through the motor ganglia (probably through the nucleus caudatus), and the pedunculi cerebri to the cerebellum.

Some of my readers may still be doubtful as to how the backward propulsion of a patient suffering from paralysis agitans is produced. It is, however, nothing more than a want of co-ordination in the continuous movements, and may be readily produced by the physician drawing the patient a few steps backwards when he will continue to go backwards, as he previously was propelled forwards, until he reaches a point of resistance.

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